October 2, 2009
Via ECFS

The Honorable Julius Genakowski,
Chairman
Federal Communications Commission
445 12th Street, S.W.
Washington, D.C. 20554

Re: GN Docket Nos. 09-47, 09-51, and 09-137
Comments – NBP Public Notice #2

Chairman Genakowski, Honorable Commissioners and Staff:

Hewlett-Packard Development Company, L.P. ("HP") hereby submits comments on the implementation of Smart Grid technology, as requested in your Public Notice dated September 4, 2009 and associated with the referenced GN Docket Nos. 0-9-47, 09-51, and 09-137.

HP is a leading technology solutions provider to consumers, businesses and institutions globally. The company's offerings span information technology (IT) infrastructure, personal computing and access devices, global services, and imaging and printing. The basic business purpose of HP is to invent, engineer and deliver technology solutions that drive business value, create social value and improve the lives of customers.

As part of our ongoing technology and utility industry thought leadership, as well as related to our ongoing service to customers, HP has recently undertaken studies of technical requirements for communications in support of Smart Grid capabilities, functions, and benefits. In the course of completing this research and business casework, we believe that we have gained unique insights as to how communications technologies and security know-how might be advantageously applied to the varied requirements of Smart Grid operation.

Further, HP is an advocate for Smart Grid policy development and industry action. HP strongly believes that Information Technology (IT) can play an enabling role in ensuring that a reliable supply of energy is available at peak times as it is constantly measured and monitored through two-way communications. Leveraging IT to promote energy efficiency, reduce costs and lower our and our customer's carbon footprint is crucial.

HP is also a member of the GridWise Alliance, which is a public – private forum that brings together a diverse set of industry stakeholders and resources to deploy, demonstrate and quantify new technologies, approaches, and business models that cut across traditional industry segments and market boundaries. The GridWise Alliance is found on the Internet at http://www.gridwise.org.

In addition to the specific comments provided, HP is including in this submission a brief case study of our company's work with Detroit Water & Sewerage Department (DWSD) titled "Making Smart Water Management Real: HP pioneering Advanced Metering Infrastructure solutions for water utilities." We believe that it is through the leverage of metering and communications technologies at organizations like Detroit Water & Sewer, our nation's utilities and utility customers are taking a big step forward in efficiency, security, and independence. The brief case study is attached hereto as Exhibit A.

We are pleased to have this opportunity to share some of these insights with the Commission and would welcome all future opportunity to provide additional insight and assistance to the Commission and its staff on this or any related matter.

Sincerely,

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Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C.

In the Matter of	)	
Implementation of Smart Grid Technology	)	GN Docket No. 09-47, 09-51, 09-137

REPLY COMMENTS OF HEWLETT-PACKARD DEVELOPMENT COMPANY, L.P.

October 2, 2009

EXECUTIVE SUMMARY

Smart Grid, intelligent network, IntelliGrid, Grid 2030; many terms of nomenclature are in circulation today, referring to the modernization of utility infrastructure. What these different terms have in common is that they all describe a utility transmission and distribution network that — through the use of information technology — is "smart" enough to adjust dynamically to network changes and to do so efficiently and securely. Many in the utility industry and in society at large are greeting the concept of the intelligent grid with optimism, especially given the operational, economic, and environmental benefits that may flow from this new investment but there are still many uncertainties about the ultimate standards for intelligent grid technologies, particularly communication technologies and protocols. Adding to this complexity is the fact that Smart Grid technology offers a wide range of possibilities, so deployments will vary depending on utility needs and requirements, geography, demography, topography, and the mandates and standards already set by individual states and public utility commissions.

However, understanding the Smart Grid and addressing the challenges of related questions is not an unsolvable problem. If the Smart Grid is defined as the convergence of information and operational technology applied to the electric grid (and to other utility distribution networks), providing more sustainable options to customers for participating in efficiency, conservation, and demand response programs and improved security, reliability and efficiency to utilities then the proper focus on deployment should be on utility communication infrastructure. Hence, HP's commentary below is focused on the technical implementation of communications for data transport that enable and support Smart Grid practices.

In the United States, electric utilities are among the largest users of privately owned and operated wide-area networks (WANs) for data communications. These WANs often include a hybrid mix of technologies including fiber optics, power line carrier systems, microwave systems, copper-wire line, and a variety of licensed and unlicensed wireless technologies. The utility WAN is designed to support applications critical to the safe and reliable operation of utility distribution infrastructure including such mission critical infrastructure as: protective relays for high voltage lines, supervisory control and data acquisition (SCADA) and energy management system (EMS), mobile fleet voice and data dispatch, distribution feeder automation, and physical security networks. Rather than relying on public communication carriers for data communications, utilities justify the costs of building and operating their own private WANs because of the highly critical nature of these applications for maintaining a reliable and secure power grid. Less-critical business applications such as corporate voice and data networks are also supported, but are not usually the driver for private WAN deployment.

A typical electric utility WAN consists of a high-bandwidth transport backbone network that backhauls large numbers of channels and applications from the utility service territory to the control center(s). Lower-bandwidth network segments, or spurs, connect individual or small groups of facilities to the backbone. Fiber optics and/or digital microwave radio are often the technologies of choice for backbone transport, whereas spurs may combine these technologies with alternatives such as copper twisted-pair wire lines, power line carrier, very high frequency (VHF) and ultra high frequency (UHF) radio links, and unlicensed wireless systems. Common carrier, leased services are used sparingly in most cases, and typically only for low-criticality applications in locations where privately owned alternatives are cost-prohibitive. These common carrier, leased services are frequently used to provision some SCADA and EMS, some distribution automation (DA) functions, some demand side management (DSM) data and controls, and some automated meter reading (AMR) -- now popularly engendered as part of the vision for the Smart Grid.

As the number of locations requiring communications service increases and the criticality of each location to the integrity of the overall grid decreases, especially where these aforementioned applications are pushed deeper into the distribution system, meaning, further out from the primary substation and closer to the customer, the challenge of the communication cost/benefit paradigm becomes more intractable. Historically, this combination of increasing costs and decreasing benefits has been the primary obstacle to deployment of more feeder-level and customer-level applications such as DA, DSM and AMR. In the historical paradigm, where these applications were deployed, costs were controlled by limiting communications to one-way systems like broadcast radio signals or narrowband, high-latency systems such as power line carriers or dial-up/plain-old-telephone service (POTS), phone lines. Unfortunately, in a Smart Grid paradigm where robust, high reliability, high availability data networks plus the highest levels of security are generally required; some low-cost, low-bandwidth communications WAN architectures are not an attractive option.

In fact, HP believes that chief issue for Smart Grid communications is the last mile question. The deployment of spur or last-mile communications for the Smart Grid, typically from a backbone node to the customer premises, poses several types of challenges: First, the network must cover a large area, especially if broadband coverage of residential customers (either to the home or to the meter) is to be provided. This has prompted some utilities to take a phased approach, deploying the Smart Grid to large-load industrial and commercial customers initially, since the bulk of the benefits of Smart Grid follow the bulk of the electrical load, while residential applications may remain in a secondary position, waiting for a clearer quantification of benefits. This balanced approach may seem to make sense economically but also may have broad political and societal ramifications as citizens see their electric rates on the rise and as environmental pressures mount. Second, the proper balancing of performance and cost is less clear for last-mile applications than it is for core-network applications. For example, losing communications with a small percentage of the DA or advanced metering infrastructure (AMI) for a short time, while undesirable, would likely pose no substantial or lasting threat to the safe and reliable operation of the overall power grid. Further, communications with a single customer or residence do not require the bandwidth and performance needed in the backbone, so low-speed communication devices with marginal signal strength that may require multiple retransmissions to complete a message can be tolerated.

To be sure, these last-mile communications issues raise vital questions like, “How reliable is reliable enough?” “How fast is fast enough?” and “At what cost?” The eased performance and reliability constraints in the last mile also mean that the number of technology options available for this portion of the WAN are more plentiful. Technologies like meshed Wi-Fi, packet-based store and forward radio networks, and broadband-over-power line (BPL), not considered reliable or robust enough for utility mission-critical infrastructure backbone, are often viable options for the last mile. Likewise, for customer premises, carrier and CATV-based services like broadband cable modem, digital subscriber line (DSL) and cellular-based wireless data networks may also be reasonable solutions, especially where utilities would be permitted and find it advantageous to negotiate bulk service rates.

Today, there is a clear political and regulatory impetus for wider deployment of Smart Grid applications, especially their deployment all the way to the distribution feeder and customer level. The proliferation of information technology and communications technology utilizing Internet protocol (IP) transport over Ethernet has made IP a strong candidate to become one of the standards for data transport. Thus, what is needed to support Smart Grid is a nearly ubiquitous IP transport network operating at bandwidths robust enough to handle conventional utility power delivery applications along with massive amounts of new data from the Smart Grid. Moreover, HP believes that these networks need to be above all secure, flexible, scalable, and extensible enough to handle future applications as they come. Communications for Smart Grid data transport require that utilities address both the backbone and the spur or last-mile communications segments.

Many electric utility communications backhauls are currently based largely on traditional time-division multiplexing (TDM) digital architectures. TDM technology, while highly reliable, was originally developed for the transport of point-to-point constant bit- rate voice communications and is not necessarily suited to cost-effective transport of point-to-multipoint “bursty” (intermittent and highly concentrated) data traffic required in an IP environment. The Smart Grid will require that many of these backbones be upgraded to backhaul Ethernet/IP data traffic at speeds ranging from one to 10 gigabits or more per second in a highly reliable manner. HP thinks that rather than replacing their legacy TDM networks, many utilities will opt initially to overlay these existing networks by overbuilding gigabit Ethernets on unused fiber, and by seeking licensed or unlicensed broadband wireless networks over existing microwave paths or seeking various wireless technologies that meet specific *in situ* needs. Whatever the solution that utilities choose, it is clear is that solving the communications challenge is the key to building a chain of success in Smart Grid deployment.

DISCUSSION

Hewlett-Packard Development Company, L.P. ("HP") hereby submits comments to the Federal Communications Commission (FCC).[1] HP has a vested interest in expanding the deployment and adoption of advanced infrastructure and services to achieve efficient implementation of Smart Grid Technology, and as a result are responding to this Public Notice.

A pioneer in California's Silicon Valley, HP was founded in 1939 by Stanford University classmates Bill Hewlett and Dave Packard. The company's first product, built in a Palo Alto garage, was an audio oscillator—an electronic test instrument used by sound engineers. One of the first HP customers was Walt Disney Studios, which purchased eight oscillators to develop and test an innovative sound system for the movie "Fantasia." Throughout its 70-year history, HP has enjoyed an enduring reputation for excellence in quality, reliability, service, and support.

Today, Hewlett-Packard is a technology solutions provider to consumers, businesses and institutions globally. The company's offerings span information technology (IT) infrastructure, personal computing and access devices, global services, and imaging and printing. The basic business purpose of HP is to invent, engineer and deliver technology solutions that drive business value, create social value and improve the lives of customers.

With annual revenue of $118.4 billion (USD), HP ranks ninth on the U.S. Fortune 500, ranks 32nd on the Global Fortune 500, seventh on BusinessWeek's Top 50 Most Innovative Companies list, and is the world's largest technology company. Led by Chairman and Chief Executive Officer Mark Hurd, HP provides sales and services in more than 170 countries. HP employs approximately 321,000 employees worldwide. HP corporate headquarters are located in Palo Alto, California.

For more than three decades, HP has supplied utility companies around the world with resources, experience, and industry knowledge dedicated to solving business problems and meeting clients' needs. Our utilities industry experts have decades of collective experience in providing innovative software solutions, information technology (IT) consulting, operations, and other planning and operational support services to some of the world's largest, most successful utility companies. Further, our deep understanding of trends and value drivers of the utilities industry enables us to provide true expertise to clients. By using our experience in other industries that have undergone deregulation, such as telecommunications, financial services, and airlines, we are well-positioned to help our clients prepare for deregulated competition and new requirements related to new business models. As a business partner, we are capable of applying a wide range of technologies, ideas, and business practices that enable our utility clients to improve their competitive position and enhance their use of assets.

As the utilities industry continues its evolution toward more intelligent, more connected, more integrated customer-driven solutions; HP is exploring new ways to help companies become more productive and responsive to their customers' needs. Our innovative systems and services are helping the industry respond to deregulation and competition and to evolve better security as the nature of utility networks becomes increasingly larger, more complex and vulnerable attack. As utilities in other countries modernize, we share our expanding base of industry knowledge to help them obtain and maintain a competitive advantage while continually innovating and contributing positively to society. HP is helping utility clients around the world and of every major utility type – electric, gas, and water – succeed in deploying a Smart Grid.

HP has long advocated for expanding the deployment of and the adoption of broadband. It has more recently advocated for implementation of Smart Grid technologies and the role the company and the technology industry can play in making this deployment happen as seamlessly and efficiently as possible. Above all HP wants to see a successful implementation of Smart Grid Technology such that our nation's utilities, businesses, consumers and citizens can capture its many significant benefits.

[1] Public Notice: Comment Sought on the Implementation of Smart Grid Technology, NBP Public Notice #2, GN Docket Nos. 09-47, 09-51, 09-137. (rel. September 4, 2009) ("PN").

I. SUITABILITY OF COMMUNICATIONS TECHNOLOGIES

What are the specific network requirements for each application in the grid? If these differ in application, how do they differ?

Reply: HP views the following as the overall requirements of a Smart Grid network to enable Smart Grid applications:

a. Smart Metering (AMI)

   i. Standards-based: The communications infrastructure needs to be based on standards to ensure support for
      1. Customer information privacy
      2. Remote service switch control
      3. Pricing event notifications

   ii. Reliable (98% availability is desirable) communications for transmissions
      1. Usage data
      2. Outage – the diverse set of utility applications and restoration notifications to provide investment protection. Applicable standards pertain to radio communication protocols, networking interfaces (TCP/IP) and industry standard security specifications.
      3. Power quality management data
      4. Tamper alerts
      5. Pricing and system event notifications

   iii. Cost effective

b. Distribution Automation

   i. Secure and reliable (99.99+% availability is desirable) communications (99.99+% availability is desirable) for
      1. Device Control – latency sensitive (milliseconds for round trip command and acknowledgement)
      2. Instrumentation – latency tolerant (seconds for round trip query and acknowledgement)

   ii. Cost effective

In addition, HP believes that Smart Grid communications networks must include and engender the following characteristics and requirements:

- **IP network:** A network that is based on IP provides the broadest possible platform for the delivery of a wide range of applications.

- **Real-time:** The network needs to provide the real-time low latency communications capabilities that are needed by such applications as distribution automation and outage detection.

- **Scalable**: The network and its network management system need to be capable of scaling to the large deployment footprints typical of many large investor-owned-utilities
- **Resilient and High Availability:** To meet the reliability requirements imposed on utilities, the network architecture must be resilient and capable of continuing to operate even in the presence of localized faults. The network must have an uptime and system availability of 5 9's (99.999%)

- **Secure:** Since the grid and its components comprise critical infrastructure, the communications infrastructure for the Smart Grid needs to provide a secure foundation for information flow and conform to industry-standard security specifications such as NERC CIP and FIPS 140-2.

- **Supports traffic prioritization:** The communications network must be capable of prioritized delivery of latency-sensitive mission critical applications such as distribution automation, over latency-insensitive traffic types such as metering data.

- **Mobile:** The network must support mobility to enable the tracking of mobile assets and workforce connectivity applications.

- **Future-proof:** In view of the long network lifetimes, the underlying network architecture and network elements must be selected so as to provide broad investment protection.

- **Cost competitive**: The communications infrastructure must be cost-competitive (CAPEX as well as OPEX) with wide area network alternatives including 3G and WiMAX.

- **Broad coverage**: The communications network should be capable of delivering broad coverage over thousands of square miles.

The figure below provides a matrix of how Smart Grid Requirements map to Smart Grid applications.

	SmartGrid Application										
Requirement	**Advanced Metering**	**Distribution Automation**	**Demand Management**	**Outage Optimization**	**Asset Management**	**Mobile Workforce**	**Power Quality Monitoring**	**Substation Security**	**PHEV**	**Net Metering**	**Future (Unknown)**
Standards-based	X	X	X	X	X	X	X	X	X	X	X
IP network	X	X	X	X	X	X	X	X	X	X	X
Real-time		X	X	X	X	X	X	X	X	X	X
Scalable	X	X	X	X	X	X	X	X	X	X	X
Resilient and High Availability	X	X	X	X	X	X	X	X	X	X	X
Secure	X	X	X	X	X	X	X	X	X	X	X
Supports traffic prioritization	X	X	X	X	X	X	X	X	X	X	X
Mobile					X	X			X		X
Future-proof	X	X	X	X	X	X	X	X	X	X	X
Cost competitive	X	X	X	X	X	X	X	X	X	X	X
Broad coverage	X	X	X	X	X	X	X	X	X	X	X

Which communication technologies and networks meet these requirements? Which are best suited for Smart Grid applications? If this varies by application, why does it vary and in which way? What are the relative costs and performance benefits of different communications technologies for different applications?

Reply: As a Smart Grid communications network architect HP believes that there are a wide array of appropriate communications technologies and networks suited to Smart Grid applications. There is wide variance in network preference for the network architect that depends on i) cost, ii) suitability to task, iii) security, iv) business requirement, v) network heterogeneity integration issues. In the simplest case, all things being equal, most Smart Grid network architects prefer fiber access broadband to radio enabled broadband. In light of this, and Since Smart Grid network architects generally seek to optimize all network capability and performance within the envelope of reasonable cost, HP believes that the FCC's best position is to promote the development of broadband radio services beyond those applications suited to long term mobile or remote area applications.

In addition, HP believes that there are several excellent sources for establishing the relative costs and performance benefits of different communications technologies for different applications. An example of such a source is the following table titled “Bandwidth, cost, and reliability comparison between communication technologies.”2

Table 2-4. Bandwidth, cost, and reliability comparison between communication technologies

	Peak Data Rate[34]	Trans-mission Range (mile)[35]	Line-of-Sight Require-ment[36]	Operating cost ($/bps)	Initial Deploy-ment Cost ($/mile)	Reliability (L: Low) (M: Medium) (H: High)	Trans-mission Topology[37]	Applications (D: data) (R: Reduced-Frame Video) (F: Full-Frame Video) (V: voice)	Acquisi-tion[38] (P: procure) (L: lease)
Wireline									
Twisted-pair	< 1.5 Mbps	15 +	NA	H	H	H	NA	D, R	L
Coaxial cable	< 100 Mbps	15 +	NA	H, L	H	M	NA	D, F	L, P
Multi-mode fiber	< 500 Mbps	< 15	NA	L	H	M-H	NA	D, F	P
Single-mode fiber	< 40 Gbps	15 +	NA	L	H	M-H	NA	D, F	P
Wireless									
900 MHz Spread Spectrum Radio	< 120 kbps	< 15	Y	L	L	H	Point-to-Point	D	P
2.4 GHz Spread Spectrum Radio	< 200 kbps	< 15	Y	L	L-M	H	Point-to-Point	D	P
5 GHz Spread Spectrum Radio	< 100 Mbps	< 15	Y	L	L-M	H	Point-to-Point	D	P
Mesh Networking (802.11)	< 6 Mbps	< 1	N	L	M-H	***[39]	Peer-to-Peer	D, R	P
Wi-Fi (802.11)	< 54 Mbps	< 1	Y	L	L-M	M-H	Point-to-Multi-Point	D, R	P
WiMAX (802.16)	< 70 Mbps	< 30	Y		M-H		Point-to-Multi-Point	D, R	P
Digital Microwave	< 155 Mbps	< 30	Y	L	M-H	H	Point-to-Point	D, F	P
2.5G Cellular (GPRS)	< 512 kbps	< 15	N	M-H	L	M	Point-to-Multi-Point	D, R, V	L
3G Cellular	< 2 Mbps	< 15	N	M-H	L	M	Point-to-Multi-Point	D, R, V	L

What types of technologies are used most often in Smart Grid applications?

Reply: HP believes that the goal of the National Broadband Plan should be to ensure that every American has access to a high capacity broadband connection. With the broadband connection and with other communications networks such as utility-owned backbone, there is optimal leverage for i) data gathering technologies, for example usage meters and voltage sensing devices and ii) command and control devices, for example SCADA and switch operation devices that are used most commonly in Smart Grid applications.

In many of the Smart Grid infrastructures that HP has architected:

[2] Yi-Chang Chiu, Haitham Logman, Mo-Ning Chiu, and Analsoni Sunkara. Guidebook for Selecting Cost-Effective Wireless Communication Technologies for Intelligent Transportation Systems; Carl Haas Center for Transportation Research, The University of Texas at Austin , October, 2003 , Revised March, 2005

Advanced Metering utilizes RF (RF, RF-Mesh, RF point to multipoint) as the predominant local area network technology. Power-line-carrier communications is also used where meter to transformer ratios are low. Other Smart Grid applications tend to use DNP# communication from the device to a WAN backhaul. WAN backhaul to the utility is typically TCP-IP based communications across fiber, cellular, WI-FI or Telephone lines.

Are current commercial communications networks adequate for deploying Smart Grid applications? If not, what are specific examples of the ways in which current networks are inadequate? How could current networks be improved to make them adequate, and at what cost? If this adequacy varies by application, why does it vary and in what way?

Reply: Generally, no, commercial communications networks are not adequate for deploying Smart Gird applications. Commercial networks commonly lack the security and reliability standards required by industry and the federal government via NERC-CIP standards. Commercial networks are also difficult to use for some Smart Grid applications due to competitive and commercial issues such as cost, latency, quality of service and data quality. If commercial carriers could provide a dedicated high throughput spectrum for utilities, the problems cited above might be alleviated.

How reliable are commercial wireless networks for carrying Smart Grid data (both in last-mile and backhaul applications)? Are commercial wireless networks suitable for critical electricity equipment control communications? How reliably can commercial wireless networks transmit Smart Grid data during and after emergency events? What could be done to make commercial wireless networks more reliable for Smart Grid applications during such events? We welcome detailed comparisons of the reliability of commercial wireless networks and other types of networks for Smart Grid data transport.

Reply: HP believes that the cost of 99.99%reliability is likely to be prohibitive for commercial carriers. Additionally, critical equipment control also requires low latency, which is normally provided by dedicated SCADA networks. Notwithstanding, commercial networks could be valuable assets to utilities and the Smart Grid if the appropriate commercial mandates and competitive access mandates were ordered by the FCC.

II. AVAILABILITY OF COMMUNICATION NETWORKS

What percentage of electric substations, other key control infrastructure, and potential Smart Grid communications nodes have no access to suitable communications networks? What constitutes suitable communications networks for different types of control infrastructure?

Reply: Although most existing control infrastructure has some sort of network attachment, the number of Smart Grid devices is expected to grow by several orders of magnitude. HP expects that a significant amount of these devices (greater than 30%) will not have access to an existing network and will require that the network be extended to reach them. Further, Control infrastructure relies on near real-time reliable communications.

What percentage of homes has no access to suitable communications networks for Smart Grid applications (either for last-mile, or aggregation point connectivity)?

Reply: It is HP's experience that this number is about 30% of homes.

In areas where suitable communications networks exist, are there other impediments preventing the use of these networks for Smart Grid communications?

Reply: Yes, in HP's experience network reliability and throughput are significant impediments to the use of these networks for Smart Grid communications.

How does the availability of a suitable broadband network (wireless, wireline or other) impact the cost of deploying Smart Grid applications in a particular geographical area? In areas with no existing networks, is this a major barrier to Smart Grid deployment?

Reply: In HP's experience the build-out of a private network communications network typically adds 25% or more to the cost of a Smart Meter deployment. It adds significantly to the capital expenditure necessary to the cost of a utility Smart Grid project and is a significant barrier to the development and deployment of Smart Metering. When Smart Grid considerations are added, the availability and costs of suitable broadband network adds to the network configuration and management costs.

III. SPECTRUM

How widely used is licensed spectrum for Smart Grid applications (utility-owned, leased, or vendor-operated)? For which applications is this spectrum used?

Reply: HP typically finds that licensed spectrum is used for AMR/AMI usage data collection. It is also common that utility SCADA applications use licensed spectrum.

How widely used is unlicensed spectrum? For which applications is this spectrum used?

Reply: Unlicensed spectrum is also commonly used for AMR/AMI usage data collection and HP finds that RF-mesh using 900 MHz communication is the predominate local area network technology in use today. This RF-mesh 900MHz communication is primarily used for meter reading and outage notification.

Have wireless Smart Grid applications using unlicensed spectrum encountered interference problems? If so, what are the nature, frequency, and potential impact of these problems, and how have they been resolved?

Reply: HP has found problems with older 900 MHz home phones and, in one case, a toaster. We have seen some coverage issues with meters in concrete basements, and steel buildings and (water meter) in-ground pits. In some cases, data collectors for these networks would need to be added or relocated to resolve issues. In other cases, HP has recommended the replacement communication cards with dedicated telephone lines.

What techniques have been successfully used to overcome interference problems, particularly in unlicensed bands?

Reply: Typically, HP has recommended that interference problems in unlicensed bands are avoided or mitigated through the alternative deployment of dedicated telephone lines and/or the extension of fiber communications.

Are current spectrum bands currently used by power utilities enough to meet the needs of Smart Grid communications?

Reply: Typically, no. Wireless solutions can provide about coverage to about 95% of a utility's customers. Commonly, commercial wireless solutions can only provide about coverage to about 70% of a utility's service territory. Hence, HP often recommends the build out of utility private networks.

Coverage: What current and future nodes of the Smart Grid are not and will not be in the coverage area of commercial mobile operators or of existing utility-run private networks?

Reply: In HP's experience, new transmission capacity is typically routed via sparsely populated areas, which is also underserved by wireless providers. Many rural communities with populations of less than 49 people per square mile do not have good commercial wireless coverage. HP finds that, on average, we have recommended that our utility clients provide new private network communications coverage to approximately 30% of the customers in any given rural service territory.

Throughput: What is the expected throughput required by different communications nodes of the Smart Grid, today and in the future, and why will/won't commercial mobile networks and/or private utility owned networks on existing spectrum be able to support such throughputs?

Reply: The principal challenge for throughput is the sheer number of devices that are required by the Smart Grid. The number of Smart Meters alone increases network traffic and data volumes exponential. During normal operation, meter data, in the form of 15 minute interval reads, needs to be transported back to the utility at least daily (and in some cases every 8 hours). At approximately 50 bytes per read, a utility with millions of meters is facing terabytes of data being transferred, managed, stored, and later analyzed.

For Smart Grid applications other than meter reading, again volume is the challenge. For instance during a significant outage where hundreds of thousands of meters might be impacted, "last gasp" messages flood the network while at the same time Smart Grid applications like outage optimization systems are trying to send signals to grid switching devices to automatically route around the outage. Massive data traffic can create equally massive data kludges that slow or even paralyze networks. At these high availability, high throughput moments, commercial networks cannot currently guarantee effective operation.

Security: What are the major security challenges, and the relative merits and deficiencies of private utility networks versus alternative solutions provided by commercial network providers, such as VPNs? Do the security requirements and the relative merits of commercial versus private networks depend on the specific Smart Grid application? If so, how?

Reply: Although IP-based networks are highly desirable from a standards perspective, IP-based networks also pose some challenges in terms of security. HP believes that that the same industry and regulatory standards for IP-based traffic (for voice and data) need to be extended to all Smart Grid devices. Because in the current environment communication technologies are controlled by device vendors (and thus are proprietary) there is a certain quotient of latent security. However, Smart Meters and other Smart Grid devices really require all the security that might be applied PC's have today, i.e. encryption, virus protection, malware protection, memory protection, network protection, etc. The best way to ensure security this necessary security is accomplished is to establish universal standards and to require that both commercial networks and private networks handling Smart Grid applications are subject to regulation, review, and compliance audits. HP believes that security is not just a set of technologies, but is also a robust set of processes and activities that must be designed into Smart Grid networks from day one, not just as an afterthought in operations.

Coordination: Are there benefits or technical requirements to coordinate potential allocation of spectrum to the Smart Grid communications with other countries? What are they?

Reply: Canada has recently approved a dedicated utility spectrum for Smart Grid. Since the US and Canada are part of the NERC grid, HP believes that coordination is advisable.

If spectrum were to be allocated for Smart Grid applications, how would this impact current, announced and planned Smart Grid deployments? How many solutions would use allocated spectrum vs. current solutions? Which Smart Grid applications would likely be most impacted?

Reply: HP believes that most utilities would strongly consider using a spectrum dedicated for utility Smart Grid use where they had not already built out their private broadband network. HP finds that most utilities would prefer using their private broadband network as much as possible if it can support the bandwidth considerations of their planned (and future) Smart Grid applications. HP further believes that all Smart Grid applications would be impacted.

IV. REAL-TIME DATA

In current Smart Meter deployments, what percentage of customers have access to real-time consumption and/or pricing data? How is this access provided?

Reply: A very small percentage of utility customers that have Smart Meters currently have access to real-time consumption data. However, many utilities in North America are currently considering a Smart Meter and Smart Grid deployment. The numbers of customers with these devices will grow significantly in the future.

What are the methods by which consumers can access this data? (e.g., via Smart Meter, via a utility website, via third-party websites, etc.)? What are the relative merits and risks of each method?

Reply: HP believes that information provided into the home via Smart Meter and then subsequently to In Home Displays (IHD) is optimal inasmuch as this provisioning gets the most relevant information is delivered in the Smart Grid network the right time, right place, and at optimal cost. However, until Smart Meter deployment reaches critical mass, this option is not the most widely available. Hence, HP believes that the next best alternative is information provided into home via a third party gateway.

What uses of real-time consumption and pricing data have been shown most effective at reducing peak load and total consumption?

Reply: HP's experience is that IHD's provisioned with real-time consumption and pricing data can provide fifteen percent to twenty percent reduction in peak residential loads. Additional reductions can be achieved if specific customers are targeted for demand response programs. In addition, programmable communicating thermostats have resulted in twenty percent reductions in peak loads in targeted residential and commercial utility customer segments, especially in geographies where there is a long heating or cooling season.

Are there benefits to providing consumers more granular consumption data?

Reply: Yes, consumers need granular data to manage their electricity consumption. Furthermore, HP believes that multiple communication channels to the consumer are required as different consumers respond to different devices and networks. While some consumers will respond to a simple in home display, others prefer will prefer data delivered to their PC, mobile device, game system, television or other consumer electronics device. Utilities must be prepared provide all of these options to consumers optimize demand response programs.

V. HOME AREA NETWORKS

Which types of devices (e.g., appliances, thermostats, and energy displays, etc.) will be connected to Smart Meters? What types of networking technologies will be used? What type of data will be shared between Smart Meters and devices?

Reply: The following devices are being connected to Smart Meters today:

- In Home Energy Displays
- Programmable Communicating Thermostats
- Load control devices Control Devices (for electric HVAC systems, hot water heaters, pool and irrigation pumps (ZigBee with Smart Profile data messaging)

In the future, HP envisions that devices that will be connected to Smart Meters include:

- Plug-In Hybrid Electric Vehicles (PHEV)
- Distributed generation equipment (e.g. home wind turbines, solar arrays)
- Smart appliances

Exhibit A

Making Smart Water Management Real: HP pioneering Advanced Metering Infrastructure solutions for water utilities

A number of economic, social, political and market forces are pushing utilities to adopt a more intelligent approach to the generation and delivery of electricity, gas and water. Forward-looking utilities now see the need for more intelligent operating structures that combine the power of information technology with the emerging capabilities of environmental technology. The resulting Smart Grids will enable utilities to anticipate and eventually shape consumer demand.

While Smart Grid is typically thought of as a solution for electric utilities, a more intelligent approach to the management of water is critical to environmental sustainability. It is important to remember experts predict a global water shortage in the next century. With the expected exponential growth of the world population to 9 billion people by 2050, there will be ever increasing urgency to improve the management of earth's clean water.

Smart Grid is not just a technology evolution, nor a fad in utility operations management. It is a complete paradigm shift that will change utilities from top to bottom. To create this more intelligent utility model – described by some as Smart Power – utilities will need to master and leverage a new generation of embedded computing, advance metering infrastructure, data and integration technologies.

Few utilities have or want to build the complex internal structures needed to plan and manage a Smart Grid environment. That is why many successful utilities have formed collaborative partnerships with "smart partners" capable of contributing the hardware, software, tools, automation and an advanced metering infrastructure needed to function in the coming smart utility environment.

Today, HP is at the forefront of providing best-in-class services and methodologies to help utilities build an advanced metering infrastructure (AMI) that automates existing manual processes, reduces operational costs, improves data quality and equips organizations with the flexibility it needs to move into the future.

When Detroit Water and Sewerage Department (DWSD), the third-largest water and sewer utility in the United States, wanted to automate meter readings and integrate meter data with its billing system and other applications, they turned to HP. Serving this 4 million+ customer base had become difficult with an 18-year-old water meter infrastructure. Manual meter reading and work order processes led to costly data entry errors, billing inaccuracies and even fraud.

HP helped DWSD build and implement one of the largest and most advanced fixed network based Advanced Metering Infrastructure solutions for a water utility in North America. DWSD's Advanced Metering Infrastructure now seamlessly integrates operations from the meter to the department's core billing applications within a highly scalable, flexible service-oriented architecture. Meter accuracy has improved, while metering costs have gone down. Today, department staff can instantly access customer meter data from anywhere at any time and resolve issues in just one phone call. Meanwhile, best-in-class reporting and business intelligence have productivity gains of up to 15 percent.

Customer satisfaction has been greatly improved now that DWSD can resolve customer issues with one phone call. DWSD is able to verify billing records and pressures and flows within the system on a day-to-day basis. Customers now have instant access to consumption data and are mostly billed according to usage rather than estimates based on previous usage. This encourages customers to take an active role in responsible water consumption and enhances conservation awareness.

The emergence of the technologies, like advanced metering infrastructure, are making Smart Grids possible and enabling utilities to provide their customers with the information and control they need to actually change their behavior patterns, reduce usage and costs, and promote conservation.